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Measurement of Post-Void Residual Urine

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Aims: To present the teaching module "Measurement of Post-void residual urine." **Methods:** This module has been prepared by a Working Group of the ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel. **Results:** In this ICS teaching module the evidence for and relevance of PVR measurement in patients with lower urinary tract dysfunction (LUTD) is summarized; in short: The interval between voiding and post-void residual (PVR) measurement should be of short duration and ultrasound bladder volume measurement is preferred to urethral catheterization. There is no universally accepted definition of a significant residual urine volume. Large PVR (>200–300 ml) may indicate marked bladder dysfunction and may predispose to unsatisfactory treatment results if for example, invasive treatment for bladder outlet obstruction (BOO) is undertaken. PVR does not seem to be a strong predictor of acute urinary retention and does not indicate presence of BOO specifically. Although the evidence base is limited, guidelines on assessment of LUTS generally include PVR measurement. **Conclusion:** Measurement of PVR is recommended in guidelines and recommendations on the management of LUTS and urinary incontinence, but the level of evidence for this measurement is not high. This manuscript summarizes the evidence and provides practice recommendations for teaching purposes in the framework of an ICS teaching module. *Neurourol. Urodynam. 35:55–57, 2016.* © 2014 Wiley Periodicals, Inc.

Key words: bladder outlet obstruction; measurement; post-void residual urine; urinary incontinence; urinary tract infections; urodynamics

INTRODUCTION

The incomplete evacuation of the bladder leads to post-void residual urine (PVR). PVR is defined as the volume (ml) of urine left in the bladder at the end of micturition.[1]

The ICS Urodynamics Committee presents the teaching module "Measurement of post-void residual urine" to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, performing analysis of voiding. The teaching module consists of a PowerPoint presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base for the ICS PowerPoint presentation is available via http://www.icsoffice.org/eLearning/ or via the QR code on this page. The presentation explains testing requirements, clinical workup and analysis. The presentation and this manuscript are based on the highest-level available published evidence; evidence has been graded according to the modification of the Oxford Center for Evidence-Based Medicine levels of evidence used by the 5th International Consultation on Incontinence.[2] Where evidence is unavailable, experts' opinion has been used and the sentence is marked as "eo" (experts' opinion).

PATHOPHYSIOLOGY

PVR is very frequently the consequence of lower urinary tract dysfunction (LUTD), with bladder outlet obstruction (BOO) and underactive or acontractile detrusor as its most prevalent examples. However, anatomical abnormalities for example, bladder diverticulum or large volume vesicourethral reflux may also cause PVR (in the latter case due to very early refilling of the bladder by the refluxed urine).[3] BOO may be a consequence of prostate enlargement (BPE), urethral or meatal stricture, or incomplete or interrupted sphincter relaxation. Rarely a bladder stone or tumor is the cause of PVR.[3] Underactive detrusor contraction can result from neurogenic, myogenic or psychogenic causes or be an effect or side effect of pharmacotherapy.[3] In any individual, especially in the elderly, or the neurologically affected, the pathophysiology of PVR may be multifactorial.[3] Furthermore, threshold values delineating what constitutes an abnormal PVR are poorly defined.[4–7]

PREPARATION

PVR is measured after a flowmetry. However PVR can also be measured after visiting a normal toilet. No evidence exists about the reliability of PVR measurements in the last

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mentioned situation. No specific patient preparation is needed. It may be reasonable to ask the patient if the voiding was similar to a typical micturition in his/her daily life.

TECHNIQUE

Ideally, the interval between voiding and PVR measurement is of short duration. Furthermore, unrepresentative results may be obtained when voiding has to occur in unfamiliar surroundings or on command with a partially filled or overfilled bladder. Although transurethral catheterization has been accepted as the gold standard for PVR measurements, this may cause discomfort for patients and carries a risk of urinary tract infection and trauma.[8] To overcome these limitations, non-invasive ultrasound bladder volume measurement has been used as an alternative to urethral catheterization since it represents a good compromise between accuracy and patients' safety/comfort.[9–11,31] Traditionally, ultrasound bladder volume estimation can be performed in two ways; either by using real-time ultrasound to directly visualize the bladder [9–10] or by using a portable bladder scanner to calculate the volume automatically without directly visualizing the bladder.[11] Portable bladder scanners have many advantages over real-time ultrasound. They are easy to use, require only basic training, and can be used on the ward, freeing up precious radiology department resources. Furthermore, a bladder scanner may reduce catheterizations; minimize the threat of urethral injuries and causes less patient discomfort. Recently, in an aim to improve accuracy, a portable ultrasound bladder scanner equipped with an additional real-time pre-scan imaging (RPI) has been introduced. It seems to be able to enhance accuracy, as it can provide examiners with pre-localization of the central target point as well as information on the shape of the bladder prior to actual scanning, reducing the variability of the measured values.[12]

INTERPRETATION

PVR and Acute or Chronic Urinary Retention

Chronic post-void residual has been widely accepted as corresponding to a consistent PVR of more than 300 ml;[4] however, some investigators have defined it as more than 400 ml,[13] as 100–500 ml [14] or have given it no definite number at all.[15] On the other hand, (chronic) PVR does not seem to be a strong predictor of acute urinary retention (AUR).[16]

BOO

It is commonly thought that the increase in residual urine indicates the severity of BOO. However, abnormal measurements of free uroflowmetry or PVR can detect only a voiding dysfunction without indicating BOO specifically. Detrusor underactivity may be the only cause of a large PVR. Nevertheless, PVR measurements are used as parameter of efficacy for medical and surgical treatments for BPO.[17–18]

PVR and Clinical Progression Of BPO

High volume PVR is associated with an increased risk of LUTS deterioration and considered a predictor of BPO progression.[19–20] In the EAU Guidelines on the Management of Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO),[21] it is paraphrased that very large PVRs may herald progression of disease. However, expert opinion prevails that very large PVR volumes (>200–300ml) may indicate detrusor underactivity and predict a less favorable response to treatment. PVR as such is not considered a stringent contraindication for watchful waiting or medical therapy. The use of PVR measurements is considered optional in men with uncomplicated LUTS undergoing noninvasive therapy. No level of residual urine, of itself, mandates invasive therapy [21] and no PVR "cut-point" is yet established for decision-making.

PVR and Antimuscarinics in Men

Some recent placebo controlled clinical trial data suggest that anti-muscarinics (alone or in combination with tamsulosin) do not increase the risk of AUR and do not produce a clinically significant increase of PVR [22–23] in men, even in the presence of BPO. However, patients with significant PVR were excluded from these studies and the safety of anti-muscarinics in men with BPO remains to be confirmed in long-term trials.

Bacteriuria

Large and/or persistent PVRs may be associated with urinary tract infections (UTI), especially in persons at risk, such as children or patients with spinal cord injury or diabetes.[24] Although this association is confirmed in a pediatric population [24] and in patients with neurogenic dysfunction,[25] other studies concluded that PVR does not correlate with bacteriuria, incontinence, immobility, impaired cognition, or neurological disease.[26–27]

Chronic Kidney Disease (CKD)

Very large PVRs (>300 ml) may increase the risk of upper urinary tract dilation and renal insufficiency.[24] A PVR > 100 ml has been associated with CKD in elderly men with LUTS;[28] however, other studies do not show a significant correlation between PVR and CKD.[29]

Female Incontinence

It is currently recommended that PVR should be measured during the assessment of women with signs and symptoms of urinary incontinence and/or overactive bladder syndrome to exclude voiding dysfunction.[3] Although the available evidence is still limited, antimuscarinic or anticholinergic medication should generally be considered if PVR is low.[30] Measurement of PVR is recommended in the management of female urinary incontinence.[31]

Children

Assessment of PVR is mandatory in a variety of pediatric patients, such as those with voiding LUTS, UTIs, vesicoureteral reflux, posterior urethral valves or neural tube defects.[24]

ACTUAL RECOMMENDATIONS

- The interval between voiding and PVR measurement should be as short as possible (eo). It is advisable to ask the patients if the voiding was similar to a typical micturition in his/her daily life (eo).
- Preferably use non-invasive ultrasound bladder volume measurement instead of urethral catheterization (LE 3).
- Measurement of PVR is recommended in the management of female urinary incontinence (LE 3).

- Assessment of PVR is considered mandatory in a variety of pediatric patients (LE 3).

EVIDENCE SUMMARY

- Unrepresentative results may be obtained when voiding has to occur in unfamiliar surroundings or on command with an only partially filled or an overfilled bladder (eo).
- A portable bladder scanner may present some advantages over real-time ultrasound (LE 3), especially if equipped with additional real-time pre-scan imaging (LE 3).
- There is no universally accepted definition of a significant residual urine volume. For clinical practice, PVR <30 ml can be considered insignificant, while residual volumes persistently >50 ml could be regarded as important (eo).
- Large PVR (>200–300 ml) often indicates LUTD and may predispose to unsatisfactory treatment results if invasive BOO treatment is undertaken (LE 3). Nevertheless, no level of residual urine, of itself, mandates invasive therapy and no PVR threshold is yet established for decision-making (LE 3).
- PVR cannot be used as a robust predictor of acute urinary retention (LE 3).
- PVR can detect only voiding dysfunction without indicating BOO specifically (LE 2–3).
- There is no evidence that PVR increases significantly in patients treated with anti-muscarinic drugs (LE 2). However, consider that patients with significant PVR were excluded from studies published up to now.
- PVR may be associated with UTI, especially in persons at risk, such as children or patients with neurogenic dysfunction (LE 3). This association among adults is far from clear (LE 3).
- Large PVR may be associated with chronic kidney diseases (LE 3).

CONCLUSIONS

Measurement of PVR is recommended in guidelines and recommendations on the management of LUTS and urinary incontinence. However, there is still lack of evidence on the precise associations of PVR with most of the lower urinary tract dysfunctions and, consequently, most of the ominous features associated with PVR are not evidence-based. We have reviewed the evidence and provided recommendations for ICS standard teaching purposes.

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